Ulnar Neck Fractures Associated with Distal Radius Fractures

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Abstract

Background There is little published data to guide management of ulnar neck fractures associated with fractures of the distal radius.

Purpose As unplanned surgery usually reflects adverse events and this injury combination is relatively uncommon, we used a large database to study the incidence of unplanned surgeries after surgical and nonsurgical treatment of distal metaphyseal ulna fractures associated with a distal radius fracture and identify factors associated with these unplanned surgeries.

Patients and Methods We identified 277 patients with an ulnar neck fracture associated with a distal radius fracture. Fifty-six (20%) ulnar neck fractures were initially treated operatively and six of them (11%) had a second, unplanned surgery. Of the 221 initially nonoperatively treated fractures, only one (0.45%) had a subsequent unplanned surgery that seemed unrelated to the fracture (ulnar nerve neurolysis).

Results Bivariate analysis showed that younger age, open fracture, multifragmentary fractures, and initial operative treatment of the ulnar neck fracture were significantly associated with unplanned surgery. A multivariable analysis was not feasible due to the small number of unplanned surgeries.

Conclusion Eighty percent of ulnar neck fractures associated with a fracture of the distal radius was treated nonoperatively in our region, and subsequent surgery for problems was very uncommon. Operative treatment and fracture complexity were associated with unplanned surgery, which reflected some measure of injury severity, technical inadequacy, and inherent problems associated with surgery.

Level of Evidence Level II, prognostic study.

Keywords
- ulnar neck fractures
- distal radius fractures
- adverse events
- unplanned surgery

Displaced fractures of the distal radius disrupt the distal radioulnar joint (DRUJ). An uncommon ulnar-sided injury associated with distal radius fractures is a fracture through the neck of the distal ulna. Treatment of such fractures varies. Our experience shows that most of these fractures align adequately once the radius is aligned (►**Fig. 1**), have little trouble healing, and do not benefit from specific treatment.[1,2] Others feel that fractures of the ulnar neck merit

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Fig. 1 A 48-year-old woman had an open fracture of her right distal radius and concomitant fracture of the distal ulna due to a fall from a standing height. (**A** and **B**) PA and lateral radiographs demonstrate a comminuted distal radius fracture and an ulnar neck fracture. (**C** and **D**) PA and lateral radiographs after plate fixation of the radius the same day. (**E** and **F**) PA and lateral radiographs 7 weeks after surgery demonstrated incomplete healing of both the radial and the ulnar fractures. (**G** and **H**) PA and lateral radiographs 4 months after surgery demonstrated good alignment and healing. PA, posteroanterior.

open reduction and internal fixation to limit the potential for non- or malunion and improve DRUJ function. There is not much published data to inform these discussions.[1–3]

Large databases can help us study uncommon conditions such as fractures of the distal ulna associated with distal radius fractures and identify adverse events of treatment such as unplanned operations.[4] In database studies, unplanned surgery usually reflects adverse events, which may lead to dissatisfaction. The purpose of this study is to test the primary null hypothesis that there are no factors associated with unplanned surgery after initial operative or nonoperative management of metaphyseal ulna fractures associated with distal radius fractures.

Patients and Methods

Study Design

After approval by our institutional review board, we queried a multiinstitutional Research Patient Data Registry containing all encounters covering three hospitals (two level I trauma centers and one community hospital tied to a level I trauma center) in a single city in the United States between 2002 and 2015. We included all patients aged 18 years or more with a fracture of the distal ulna associated with a fracture of the distal radius using International Classification of Disease 9 (ICD-9) codes, namely, 813.22, 813.32, 813.43, 813.44, 813.53, 813.54, 813.82, and 813.92 resulting in 1,314 patients who were treated for a fracture of the ulna. To determine treatments, we then cross matched this cohort with Current Procedural Terminology (CPT) codes for open treatment of ulnar fractures (25651, 25652, 25574, 25575, 25607, 25545, and 25240) and closed treatment of ulnar fractures (25535, 25560, 25565, and 25605).

Two authors (S.Ö., S.F.F.) then assessed the radiographs to identify metaphyseal fractures and included every fracture with a fracture line in the ulnar metaphysis. When it was not clear if the fracture was metaphyseal, both pre- and post-treatment radiographs were presented to our senior author (D.R.), who then made a decision about inclusion. This resulted in an initial cohort of 339 patients. We excluded 39 patients with an isolated ulnar neck fracture, 17 patients with an associated fracture of the radial shaft rather than the distal radius, and 6 patients due to inaccessible chart information or radiographs, leaving us with a final cohort of 277 patients (►**Table 1**).

We recorded patient characteristics (age, sex, insurance type, obesity, smoking status, alcohol misuse), injury characteristics (side of injury, open or closed fracture, associated injuries), and treatment details (type of treatment, time from injury to treatment, supervising healthcare provider, loss of fixation after treatment and unplanned surgery) from the medical records. Surgeons that operated on more than 10 wrist fractures in our study timeframe were considered high volume.

Table 1 Characteristics of study population and their relation to unplanned surgery of ulna

	All patients	No unplanned surgery	Unplanned surgery	
Variable	**($n = 277$)**	**($n = 270$)**	**($n = 7$)**	***p*-Value**
Patient characteristics				
Age, mean ± SD, y	65 ± 18	66 ± 17	51 ± 13	0.017[a]
Sex, *n* (%)				>0.99[b]
Male	49 (18)	48 (18)	1 (14)	
Female	228 (82)	222 (82)	6 (86)	
Alcohol abuse, *n* (%)	31 (11)	29 (11)	2 (29)	0.18[b]
Obesity, *n* (%)	35 (13)	35 (13)	0 (0)	0.60[b]
Smoking, *n* (%)	92 (33)	90 (33)	2 (29)	>0.99[b]
Workmen's comp insurance, *n* (%)	3 (1.1)	3 (1.1)	0 (0)	>0.99[b]
Injury characteristics				
Side of injury, *n* (%)				0.058[b]
Left	144 (52)	143 (53)	1 (14)	
Right	133 (48)	127 (47)	6 (86)	
Associated ipsilateral injuries, *n* (%)				0.11[b]
Carpal fracture	5 (1.8)	5 (1.9)	0 (0)	
Hand fracture	7 (2.5)	7 (2.6)	0 (0)	
Forearm fracture	3 (1.1)	3 (1.1)	0 (0)	
Upper arm fracture	13 (4.7)	12 (4.4)	1 (14)	
Clavicular fracture	2 (0.72)	1 (0.37)	1 (14)	
Scapular fracture	1 (0.36)	1 (0.37)	0 (0)	
>1 ipsilateral fragment	2 (0.72)	2 (0.74)	0 (0)	
Fracture characteristics				
Open fracture, *n* (%)	62 (22)	57 (21)	5 (71)	0.007[b]
Fracture line, *n* (%)				0.044[b]
Oblique	119 (43)	116 (43)	3 (43)	
Transverse	125 (45)	124 (46)	1 (14)	
Multifragmentary	33 (12)	30 (11)	3 (43)	
Articular involvement, *n* (%)	5 (1.8)	4 (1.5)	1 (14)	0.12[b]
Displaced fracture, *n* (%)	133 (48)	128 (47)	5 (71)	0.27[b]
Associated ulnar styloid base fracture, *n* (%)	66 (24)	64 (24)	2 (29)	>0.67[b]
Treatment characteristics				
Time injury to treatment, median (IQR), d	<1 (0–3)	<1 (0–3)	<1 (0–3)	0.67[a]
Cases treated by experienced surgeon,[c] *n* (%)	182 (66)	177 (66)	5 (71)	>0.99[b]
Initial surgical treatment of ulna, *n* (%)	56 (20)	50 (19)	6 (86)	<0.001[b]

[a]Wilcoxon rank-sum test.
[b]Fisher's exact test.
[c]Surgeons who comply to our volume criterion.

Fifty-six (20%) of distal ulna fractures were treated operatively: 40 with plate and screws (71%), 9 through pinning (16%), 5 with tension bands (9%), and 2 had a distal ulna resection (4%). Seven patients (2.5%) had an unplanned surgery after initial treatment, including 1 of the 221 (0.45%) patients initially treated nonoperatively (ulnar nerve decompression) and 6 of the 56 patients initially treated operatively (11%, ►**Table 1**). The most common indications for unplanned surgery of the ulna were symptomatic implants ($n = 3$; 43%) and loss of fixation within 1 month

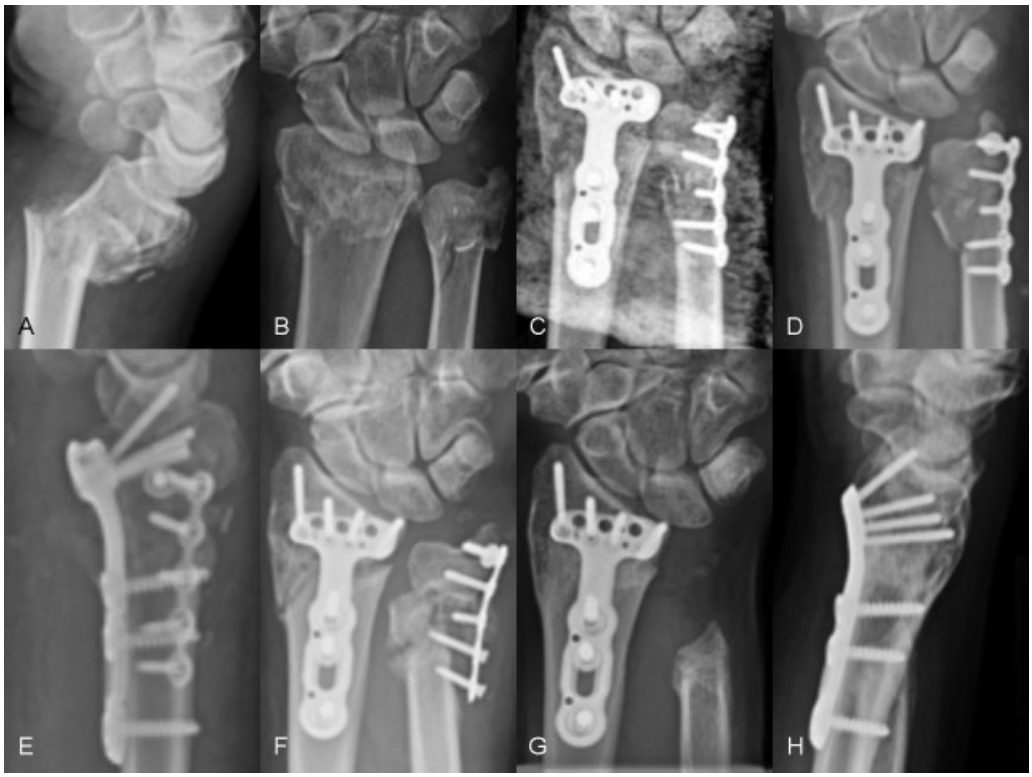

Fig. 2 A 54-year-old woman had an open fracture of her right distal radius with concomitant fracture of the distal ulna due to a fall from a standing height. (**A** and **B**) PA and lateral radiographs after injury demonstrated distal radius and ulnar neck fractures with dorsal angulation. (**C**) A PA radiograph after plate fixation of both the radius and the ulna demonstrated improved alignment and internal fixation. (**D** and **E**) PA and lateral radiographs 2 weeks after surgery showed no change in alignment. (**F**) A PA radiograph 8 weeks after surgery demonstrated loosening of the ulnar plate and screws. (**G** and **H**) PA and lateral radiographs after Darrach's resection. PA, posteroanterior.

($n = 2$; 29%; ►**Table 2**). None of these subsequent surgeries were part of the initial treatment plan. Both losses of fixation failures were complex fractures where the fragmentation of the ulnar neck and the distal radius extended to the diaphysis. Of the associated distal radius fractures, 17 patients had unplanned surgery of the distal radius after initial treatment (6%), with symptomatic implants ($n = 10$; 4%) as the most common indication for unplanned surgery and concern for nonunion (►**Fig. 2**) as the least common indication for unplanned surgery of the ulnar neck (►**Table 2**).

Statistical Analysis

We described the frequencies of dichotomous and categorical variables. Continuous variables with a normal distribution were reported as mean values and standard deviations (SD). We reported the median and interquartile range (IQR) for continuous variables with a nonparametric distribution. We used the two-sample *t*-test with equal variances to study the association between normally distributed continuous and discrete variables, Fisher's exact test for the association between discrete variables, and the Wilcoxon rank-sum test for the association between continuous variables with a nonparametric distribution and discrete variables. We initially planned to perform a multivariable analysis, but this was infeasible due to the low number of unplanned surgery events for ulnar neck fractures. A power analysis based on Fisher's exact test indicated that the sample size of unplanned surgery ($n = 7$) and no unplanned surgery ($n = 270$) provided 99% power to detect a difference in proportions with a delta of 0.67. We considered two-tailed *p*-values of less than 0.05 to be significant.

Results

In bivariate analysis, younger age, open fracture, multifragmentary fractures, and initial operative treatment of the ulnar neck fracture were associated with unplanned surgery of the ulnar metaphysis (►**Table 1**). There were insufficient reoperations for our planned multivariable analysis.

Discussion

There is little published data to guide surgical management of an ulnar neck fracture associated with fracture of the distal radius. Large databases are useful for studying uncommon injury combinations such as this one. While such databases have limited specific information about symptoms and physical examination, surrogates such as unplanned surgery can be used to estimate adverse events and dissatisfaction.[4] This study used a large research database to study the incidence of unplanned surgery after treatment of metaphyseal ulna fractures associated with fractures of the distal radius and identify factors associated with unplanned surgery.

Table 2 Characteristics of unplanned surgeries

		Ulna	
	Distal radius	Operative treatment	Nonoperative treatment
Variable	($n = 277$)	($n = 56$)	($n = 221$)
Complication			
Concern for nonunion	1 (0.36)	1 (1.8)	–
Malunion	1 (0.36)	–	–
Loss of fixation	2 (0.72)	2 (3.6)	–
Symptomatic implants	10 (3.6)	3 (5.4)	–
Acute carpal tunnel syndrome	3 (1.1)	–	–
Ulnar nerve compression	–	–	1 (0.45)
Total	17 (6.1)	6 (11)	1 (0.45)
Procedure			
Implant removal	9 (3.3)	3 (5.4)	–
ORIF	1 (0.36)	–	–
Pinning	1 (0.36)	–	–
Revision ORIF	3 (1.1)	1 (1.8)	–
Revision pinning	–	1 (1.8)	–
Darrach's resection	–	1 (1.8)	–
Ulnar nerve neurolysis	–	–	1 (0.45)
Median nerve neurolysis	1 (0.36)	–	–
Carpal tunnel release	2 (0.72)	–	–
Total, *n* (%)	17 (6.1)	6 (11)	1 (0.45)

This study should be interpreted in light of its strengths and limitations. First, our research database comprised data from two level I trauma centers and one affiliated community hospital in an urban city and may not apply to other settings. Second, since we used ICD-9 and CPT codes to identify our cohort, we relied on accurate recordkeeping and there may be a small amount of miscoding as is typical for retrospective database studies. This is a known characteristic of database studies and has minimal influence on the results.[5,6] Third, even though database studies are well suited to study uncommon injuries, reoperation was sufficiently uncommon that we were unable to conduct a multivariable analysis. Fractures treated nonoperatively might be different from fractures with initial operative treatment (for instance, many were open fractures) in ways that we could not completely account for without multivariable analysis. Also, some of the fixation failures might be attributable to technical deficiencies—we did not study surgical technique. Last, it is possible that some patients had subsequent surgery outside our system, but based on prior research and knowledge of referral patterns, this is likely to be very uncommon.[7]

In bivariate analysis, age, open fracture, multifragmentary fractures, and initial operative treatment of the ulnar neck fracture were significantly associated with unplanned surgery of the ulnar neck. Fewer than 3% of ulnar neck fractures associated with fractures of the distal radius had subsequent surgery (11% of those treated operatively and fewer than 1% of those treated nonoperatively). To date, there is limited published data regarding unplanned surgery of ulnar neck fractures associated with distal radius fractures. Four small case series described unplanned surgery in 0 to 33% of patients.[1,8–10] A recent review concluded that there is no consensus on operative versus nonoperative management of ulnar metaphyseal fractures.[11] One case series described one unplanned surgery of the ulnar neck after an open fracture.[1] In our cohort, five of seven unplanned surgeries (71%) after initial operative treatment were open injuries. Since open fractures are treated operatively[12] and both open fracture and initial surgical treatment of the ulna were associated with unplanned surgery, a larger cohort allowing a multivariable analysis would help identify an independent association between open fractures and unplanned surgery of the ulnar neck. However, establishing a cohort large enough to be able to perform this multivariable analysis is difficult in terms of feasibility: larger database studies merely based on coding alone would not be meaningful because the codes themselves, without manual review of each of the radiographs, are not specific enough for accurate identification of ulnar neck fractures.

Ulnar neck fractures associated with distal radius fractures raise concerns for healing and hindrance of forearm rotation due to malunion. Our data suggest that there needs to be little concern for these issues, at least in the setting of internal fixation of the distal radius fracture. Based on our experience, it seems that the distal ulna aligns adequately when the distal radius is aligned and fixed with a plate and screws and uncommonly creates problems leading to surgery after initial nonoperative treatment. Additional research with larger cohorts might help determine if there is a subset of ulnar neck fractures associated with distal radius fractures that might benefit from operative treatment.

Note

The work was performed at the Hand and Upper Extremity Service, Department of Orthopaedic Surgery, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts. The IRB approval number is #2009P001019/MGH.

Funding

None.

Conflict of Interest

None.

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